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THE MISSISSIPPIAN-PENNSYLVANIAN UNCONFORMITY AND THE SHARON CONGLOMERATE[1]

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There exists in northern Ohio a well-defined boundary between the strata of the Mississippian and Pennsylvanian ages, a boundary marked by a pronounced unconformity. The upper limit of the Mississippian is the top of the well-known Cuyahoga formation, and the lower limit of the Pennsylvanian is the bottom of the equally well-known Sharon conglomerate.

So far as the writer is aware the Sharon has been generally regarded as a formation of general extent around the northern and northwestern border of the Appalachian coal basin, and resting upon the Mississippian in a continuous sheet except where removed by erosion.

Field work the past summer in Mahoning, Trumbull, Portage, Summit, and Geauga counties has revealed. some facts that lead the writer to believe that the Sharon conglomerate is not the simple formation that it has been thought to be, and that it has a setting of unusual interest.

Following its outcrop from place to place, the formation is found to change in structure quickly, to disappear suddenly, and to be absent over considerable areas, letting later rocks form the contact with the Cuyahoga. Where its development is greatest, it lies in troughs of the Cuyahoga. Further, it is found to occur in belts having a more or less north-and-south direction, and these belts, in places at least, are not now and never have been connected from east to west. This is due, in part at least, to the fact that the conglomerate lies between ridges of the Cuyahoga, and not alone to post-Pennsylvanian erosion.

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[1] Published by permission of Dr. J. A. Bownocker, state geologist of Ohio. Presented at the twentieth meeting of the Ohio Academy of Science, Akron, November 25, 1910.

This manner of occurrence calls attention to the surface upon which the Pennsylvanian rests. Whatever may be the case elsewhere, the writer believes that greater erosion of the upper Mississippian occurred in northern Ohio than is generally known. Instead of the Sharon resting upon a nearly uniform plane, it is found that the surface of the Cuyahoga has a relief of nearly 200 feet, and it is significant that where the depressions are greatest, the Sharon is also thickest. The regional or belt-like occurrence of the conglomerate, and its apparent relationship to depressions in the Cuyahoga, along with the structure and variability of the stratum, have led the writer to the conclusion that these depressions are creek and river valleys, and that the conglomerate is a deposit of stream gravels, and that the overlying sandstones of the Pottsville are, to a greater or less extent, river and delta deposits.

Some of the data on which this view is based are added. Valleys in the Cuyahoga formation are of general occurrence. The most conspicuous and deepest one so far found may be noted in some detail. This valley lies in the eastern edge of Portage and Geauga counties, about half-way between Akron and the state line, and its course is roughly north and south. At Akron, the top of the Cuyahoga formation lies about 940 above sea; due east, at Mineral Ridge, west of Youngstown, at 962; at Newton Falls, between these two points, and 5 miles north of the Akron-Mineral Ridge line, it lies below 850, or about 100 feet lower than to the east or west. If such a line be drawn from east to west half-way between Akron and Cleveland, the same depression in the Cuyahoga is again found. At Brandywine Falls, 15 miles north of Akron, the top of the Cuyahoga formation lies at 1,040; near Howland Springs, due east of Brandywine, at 1,044; and at Nelson Ledges between these two points at 956, or again nearly 100 feet lower.

Another east and west comparison may be cited. At Burton, due east of Cleveland, the top of the Cuyahoga lies at 1,090 and due east on the state line at 1,190, or 100 feet higher. These three middle points—Newton Falls, Nelson Ledges, and Burton—are in line, roughly, north and south, and are clearly in a depression of the Cuyahoga formation, since rock of this formation lies higher both to the east and west. Further, this depression cannot be assigned to a syncline, as is proven by the nearly horizontal position of the Berea in the same direction. It is worthy of note that the Sharon and overlying sandstones in the line of this old valley reach their greatest development in Ohio, and form a great body of conglomerate and sandrock extending southward from southern Lake County, through Geauga and Portage counties, at least as far south as northern Stark County. The evidence is strong that the conglomerate and overlying sandstones in this great ridge are stream deposits, and will be discussed later.

It may be objected that the distances involved in the three lines across this supposed valley are of such length as to be of doubtful value. Data are at hand, however, which confirm fully what the three lines of elevation show. At Brandywine the Sharon base is 210 feet above the Berea; due east at Nelson Ledges only about 75 feet; near Newton Falls only about 75 feet; but on the state-line nearly due east of Nelson Ledges nearly 300. The meaning of these figures is clear, and shows deep erosion, which is still further confirmed by the presence of hills of the Cuyahoga in the very region in which the erosion was greatest. As stated above, the top of the Cuyahoga near Newton Falls lies below 850 and in 2¼ miles north rises to 1,040 above sea-level. It therefore forms a hill at least 190 feet high, with no trace of the Sharon or overlying sandstones. Within 3½ miles to the northwest from this hill, and in a direction opposed to the dip, the surface sinks to 919 feet at least. At Nelson Ledges the conglomerate is about 75 feet thick, and one solid mass from bottom to top. It appears to the observer that it may be expected to continue for miles to the north, but instead it thins out quickly on the steep slope of another Cuyahoga hill, which rises from 956, at the base of the Ledge, to 1,107, a rise of 151 feet in 1 mile. Within 2 miles to the northwest from this hill, the surface drops again to 990, or 117 feet, as seen in the Parkman gorge. From this point the surface rises again to the northeast, 180 feet in 2½ miles, then falls toward the northwest. At Newton Falls, there is a like rise toward the northeast from below 850 to 941, in about 3 miles. Now all points which show these old hills are on or near the eastern margin of this rock ridge, and in every case bear evidence of a more or less westerly slope toward the ridge. They are clearly hills bordering a valley, and are conclusive evidence of former dissection to a depth of nearly 200 feet. This same hill and valley topography of the Cuyahoga is found all through eastern Trumbull and northern Mahoning counties, with the conglomerate often absent, and with the Sharon coal lying close above the Cuyahoga.

One of the finest exposures of the unconformity occurs in Mineral Ridge, south of Niles, and near the Mahoning-Trumbull line. A deep east-and-west ravine cuts through a north-and-south Cuyahoga ridge finely exposing the contact, showing the horizontal shale and flaggy layers of the Cuyahoga, overlain by the steeply inclined strata of the Pennsylvanian. The slope of the Cuyahoga is toward the east, and at an angle of about 25°, is ragged or stair-step like, and is directly overlain by 2 or 3 feet of crude, mixed sandstone, without lamination or bedding planes, which grades quickly into a bluish shale, then to a carbonaceous shale which carries the well-known and formerly much-worked bed of iron ore. The ore is a highly ferruginous limestone, which is certainly the Lowellville limestone. Directly above the ore is a bed of coal—the Mineral Ridge coal—which lies only 8 feet above the Cuyahoga. The sandstone, shale, ore, and coal all lie at the same steep angle above the Cuyahoga.

I have stated above that the Sharon conglomerate bears evidence of being a stream deposit. This appears from its position, its constitution, and its structure. In some places it is little else than a mass of quartz pebbles which range in size from coarse sand to half the size of the fist. Commonly the stratum is an alternation of sand beds and pebble layers, of constant variation both horizontally and vertically. Bottom-set, fore-set, and top-set beds are common. The sudden change from sand to gravel, and the very variable structure of the sand beds, all of which may be repeated several times in a single rock face, can be accounted for only by stream action. There is not any feature of the conglomerate that stream action does not produce. On the other hand, the writer is unable to conceive of any other agency capable of producing a like stratum.

It will be interesting to note the most exaggerated conglomeratic development found. It occurs at the base of the Sharon as exposed in the gorge at the village of Parkman, Geauga County. Lying directly upon the Cuyahoga, and representing a stream velocity of probably 3 miles an hour, is a 3-foot bed composed not of pebbles alone, but of cobble stones, or pieces of flagstone from the Cuyahoga, some angular, some rounded and flat and well worn, 2 to 3 inches thick and more than a foot in diameter, standing and lying in all positions and mixed with sand and pebbles. It is a veritable picture of the stones and gravel and sand all mixed that we have all seen many times on the inside curve of streams. A more convincing evidence of stream deposit in former ages can hardly be found.

It is worthy of note here that two distinct stages in the deposition of the Sharon are displayed in this gorge. At 10 or 12 feet above the base the conglomeratic character is entirely absent, a rather fine soft sandstone occurs, the top of which is quite undulating, as if eroded. Resting directly upon the undulating surface, with a sharp line, is the massive conglomeratic rock characteristic of the Sharon. The transition is sudden and very conspicuous and is well shown at a number of points in the gorge.

At Nelson Ledges the base of the conglomerate lies at 956, and ½ mile west conglomerate is found at 1,160 above sea. This whole thickness of 204 feet is not to be assigned to the Sharon, however. Overlying sandstones are conglomeratic in this locality and sufficiently so to be mistaken easily for the Sharon itself. Two miles south of this point and about ¾ mile south of Nelson village at Ledge Haven Mill conglomerate rock is found on Tinker Creek. There are clearly two stages of conglomerate formation here. The bed of the creek below the fall is conglomerate of unknown thickness. It is directly overlain by 5 to 6 feet of dark gray sandy shale and this is overlain in turn by 30 to 40 feet of conglomerate. The top of the lower stratum lies at 952, as seen at the foot of the fall beside the mill. The shale stratum is strongly suggestive of the horizon of the Sharon coal. It also strongly suggests relationship to the two-stage phase of the conglomerate observed in the Parkman gorge. At the latter place this transition occurs at a level of about

1,000 feet above sea, and is nearly 5 miles north of the above mill, and when dip is taken into account the probability is very strong that the phenomena seen at the two places belong to the same horizon.

A quite singular feature occurs in this shale at the fall. Near its middle, and imbedded in it, lies a lenticular mass of conglomerate a foot thick and probably weighing nearly a ton. It contains large quartz pebbles, much pyrites of iron, and an impression of a calamite. How was it transported to this place where only fine sediments were being deposited? Where did it come from, and from what rock formation was it detached? For the conglomerate beneath must have been only a stratum of sand and gravel when it was deposited. In central Ohio three other formations intervene between the Cuyahoga and the base of the Pennsylvanian, the lower one of which—the Black Hand—is known to be conglomeratic in part. Is this conglomerate block imbedded in this shale a remnant of the Black Hand which once may have overlain the Cuyahoga in northern Ohio, and was completely removed by erosion before the close of the Mississippian? These are questions to which only further study may reveal the answer.